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EXAMINER
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UMEZ ERONINI, LYNETTE T

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 03/29/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/993,832

Applicant(s)

KWEAN ET AL.

Examiner

Lynette T. Umez-Eronini

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The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 04 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) 1-8 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 9-16 and 18-22 is/are rejected.
- 7) ☒ Claim(s) 17 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 11/6/2001.
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Election/Restrictions***

1. Applicant's election without traverse of claims 9-22 in filed 3/4/2002 is acknowledged.

### ***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 9 and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 9, line 2 "the ratio of fluorine . . ." lacks antecedent basis.

In claim 19, lines 2-3, "contact hole is in a range of about 8-17" is indefinite for failing to specify units of the aspect ratio of the contact hole.

### ***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an

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application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 9-13 are rejected under 35 U.S.C. 102(e) as being anticipated by Okamoto et al. (US 6,589,435 B1).

Okamoto teaches forming contact holes by means of plasma etching, such that the contact holes are formed from the top surface of a silicon oxide insulating film (**31**) down to a wiring layer, by using a process gas containing  $C_4F_8$ , or  $C_5F_8$ ; CO; and an inactive carrier gas (Abstract and column 4, lines 39-43), which reads on,

A method of etching silicon oxide comprising the steps of: preparing an etching gas composition comprising a mixture of carbon fluoride gas in which the ratio of fluorine atoms relative to carbon atoms is less than 2 and an auxiliary gas including hydrogen, fluorine and carbon atoms; and implementing an etching procedure by generating a plasma of said etching gas composition and then applying said plasma onto said silicon oxide, **in claim 9**; and

wherein said carbon fluoride gas is at least one member selected from the group consisting of  $C_5F_8$ ,  $C_4F_6$ ,  $C_3F_4$  and  $C_2F_2$ , and mixtures thereof, **in claim 10** and

wherein said auxiliary gas is at least one member selected from the group consisting of  $CH_2F_2$  and  $CHF_3$ , and mixtures thereof, **in claim 11**.

Okamoto teaches, using as a mixture of  $C_4F_8$ , CO, Ar, and  $CHF_3$  gases (same as applicants' auxiliary gas), their flow rates were changed in ranges of from 1 to 5 sccm, from 50 to 200 sccm, from 300 to 700 sccm, and from 3 to 18 sccm, respectively (column 7, lines 20-24), which encompasses,

a ratio of the volumetric flow rate of said auxiliary gas with respect to that of said carbon fluoride gas is in a range of about 0.1-3.0, **in claim 12**; and

reads on, said etching gas composition comprises CO, and encompasses a ratio of the volumetric flow rate of said CO with respect to that of said carbon fluoride gas is in a range of about 1-30, **in claim 13**.

6. Claims 14-16 are rejected under 35 U.S.C. 102(e) as being anticipated by Okamoto et al. (US 6,589,435 B1).

Okamoto teaches,

A method of manufacturing a contact hole of a semiconductor device (Abstract). The method comprises:

forming a silicon oxide layer by depositing silicon oxide on a semiconductor substrate (column 5, lines 6-9);

forming a photoresist pattern as an etching mask on said silicon oxide layer (column 5, line 16);

loading said substrate on which said photoresist pattern is formed into a reaction chamber (column 5, lines 23-25);

introducing an etching gas composition comprising a mixture of carbon fluoride gas in which the ratio of fluorine atoms relative to carbon atoms is less than 2 and an auxiliary gas including hydrogen, fluorine and carbon atoms into said reaction chamber (column 4, lines 38-40; column 5, lines 35-37, column 6, lines 21-26; and column 7, lines 21-25 and 55-59); and

producing plasma of said etching gas composition and then etching said silicon oxide layer by the produced plasma (column 5, lines 55-62), **in claim 14.**

Okamoto teaches plasma etching contact holes are formed from the top surface of a silicon oxide insulating film (**31**) down to a wiring layer, by using a process gas containing  $C_4F_8$ , or  $C_5F_8$ ; CO; and an inactive carrier gas (Abstract and column 4, lines 39-43) wherein the flow rate of a mixture of the process gas of  $C_4F_8$  gas, CO gas, Ar gas, and  $CHF_3$  gas (same as applicants' auxiliary gas), were changed in ranges of from 1 to 5 sccm, from 50 to 200 sccm, from 300 to 700 sccm, and from 3 to 18 sccm, respectively (column 7, lines 20-24). The above reads on,

wherein said carbon fluoride gas is at least one member selected from the group consisting of  $C_5F_8$ ,  $C_4F_6$ ,  $C_3F_4$  and  $C_2F_2$ , and mixtures thereof, and wherein said auxiliary gas is at least one member selected from the group consisting of  $CH_2F_2$  and  $CHF_3$ , and mixtures thereof, and encompasses,

a ratio of the volumetric flow rate of said auxiliary gas with respect to that of said carbon fluoride gas to said reaction chamber is in a range of about 0.1-3.0, **in claim 15.**

The said above further reads on,

wherein said etching gas composition further comprises CO, and encompasses a ratio of the volumetric flow rate of said CO with respect to that of said carbon fluoride gas to said reaction chamber is in a range of about 1-30, **in claim 16.**

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***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Okamoto (US '435 B1) as applied to claim 14 above, and further in view of Chen et al. (US 6,319,822).

Okamoto differs in failing to teach wherein said photoresist is a photoresist applicable for DUV wavelength.

Chen teaches a method of forming a contact opening to a semiconductor element by etching an silicon oxide interlevel dielectric layer using a hard mask

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that is patterned by DUV photolithography using thin photoresist (column 3, lines 49-56), which reads on said a photoresist applicable for DUV wavelength.

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Okamoto by employing a DUV photoresist as taught by Chen's for the purpose of selectively etching an insulative layer using high resolution photolithography (column 7, lines 56-62).

10. Claims 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Okamoto (US '435 B1).

Okamoto succeeds at disclosing a method of forming contact hole and silicon oxide layer, as in the claimed invention. It is noted that the reference is silent about the specific ranges of the aspect ratio of the contact hole, the diameter of the contact hole, and the thickness of the silicon oxide layer as specify respectively in claims 19, 20, and 21.

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to select any combination of aspect ratios and diameters of a contact hole and thickness of a silicon oxide layer, including those defined in applicants' for the purpose of obtaining the claimed invention.

11. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Okamoto (US '435 B1) as applied to claim 14 above, and further in view of Jeng et al. (US 6,476,488 B1).



Okamoto differs in failing to teach wherein said semiconductor device is a DRAM device, and said contact hole is an MC (metal contact hole) for connecting a metal layer formed on said silicon oxide layer formed on a capacitor with an impurity doped region.

Jeng discloses a detailed description of making a DRAM circuit having lightly doped source/drain area and metal contacts, which are formed by etching openings in SiO<sub>2</sub> layer to the N<sup>+</sup> and P<sup>+</sup> contact on a substrate, using an RIE and an etchant gas mixture of C<sub>4</sub>F<sub>8</sub>, C<sub>5</sub>F<sub>8</sub>, CO, O<sub>2</sub>, and Ar (column 2, line 54 - column 8, line 32; column 6, lines 56-65; and FIGS. 2-11), which reads on said semiconductor device is a DRAM device, and said contact hole is an MC (metal contact hole) for connecting a metal layer formed on said silicon oxide layer formed on a capacitor with an impurity doped region

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Okamoto by using Jeng's method of making a DRAM device for the purpose of reducing current leakage and improving circuit performance of DRAM devices (column 8, lines 30-32).

***Allowable Subject Matter***

12. Claim 17 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ltue

March 20, 2004

**NADINE G. NORTON**  
**SUPERVISORY PATENT EXAMINER**

